PHOTOCHEMICAL REACTIONS OF CYANOACETYLENE AND DICYANOACETYLENE: POSSIBLE PROCESSES IN TITAN'S ATMOSPHERE

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Titan has an atmosphere which is subject to dramatic chemical evolution due mainly to the dramatic effect of the UV flux from the Sun. The energetic solar photons and other particles are converting the methane-nitrogen atmosphere into the unsaturated carbon compounds observed by the Voyager probes. These same solar photons are also converting some of these unsaturated reaction products into the aerosols observed in the atmosphere which obscure the view of the surface of Titan. In particular, the photochemical reactions of cyanoacetylene, dicyanoacetylene, acetylene and ethylene may result in the formation of the higher hydrocarbons and polymers which result in the aerosols observed in Titan's atmosphere.

Polymers are the principal reaction products formed by irradiation of cyanoacetylene and dicyanoacetylene. Irradiation of cyanoacetylene with 185 nm of light also yields 1,3,5-tricyanobenzene while irradiation at 254 nm yields 1,2,4-tricyanobenzene and tetracyanocyclooctatetraenes. Photolyses of mixtures of cyanoacetylene and acetylene yields mono- and di- cyanobenzenes. 1-Cyanocyclobutene is formed from the photochemical addition of cyanoacetylene with ethylene. The photolysis of dicyanoacetylene with acetylene yields 2,3-dicyano-1,3-butadiene and 1,2-dicyanobenzene. Tetracyanocyclooctatetraene products were also observed in the photolysis of mixtures of dicyanoacetylene and acetylene with 254 nm light. 1,2-Dicyanocyclobutene is obtained from the photolysis of dicyanoacetylene and ethylene. Reaction mechanisms will be proposed to explain the observed photoproducts.